REMARKS

Claims 11 and 26 have been canceled without prejudice. New claims 38-43 have been added. Specifically, new independent claim 38 incorporates the subject matter of claim 1 and further recites that "the support film is selected from the group consisting of polyester films and polyethylene terephthalate films" as supported on page 5, line 24, to page 6, line 3, of specification as originally filed.

New dependant claims 39, 40 and 41 depend upon independent claims 1, 19 and 36, respectively, and further recite "wherein the protecting film (C) is made of resin filtered after thermal melting" as supported on page 14, lines 12-16, of the specification as originally filed.

New independent claim 42 corresponds to claim 11 rewritten in independent form. Therefore, new independent claim 42 has the same scope as previous claim 11. New independent claim 43 corresponds to claim 26 rewritten in independent form. Therefore, new independent claim 43 has the same scope as previous claim 26.

This amendment adds no new matter to the application.

The Rejections

Claims 1-10, 13-19, 21-25 and 28-37 stand rejected under 35 U.S.C. § 102(b) as anticipated by Taguchi (U.S. Patent 4,360,582). Claims 11 and 26 stand rejected under 35 U.S.C. § 103(a) as unpatentable over Taguchi (U.S. Patent 4,360,582) in view of Hatanaka (U.S. Patent 6,133,343). Claims 12 and 27 stand rejected under 35 U.S.C. 103(a) as unpatentable over Taguchi (U.S. Patent 4,360,582) in view of Hoffman (U.S. Patent 4,710,446).

Applicants respectfully traverse the rejection and request reconsideration of the present application for the following reasons.

The Invention

The present invention provides a photosensitive film usable in metal etching fabrication of lead frames, metal masks, and the like, with reduced generation of air voids which cause formation of defective patterns and breakage of wire. The problem solved by the present invention is to reduce the formation of air voids on a substrate, such as a metal, after removing the protecting film from the photosensitive resin layer formed on a support film. The present inventors have found for the first time that such air voids are caused by very fine fish eyes, difficult to find with the naked eye, in the protecting film in the photosensitive film.

Furthermore, formation of air voids is related to film thickness of the photosensitive layer, so a thinner photosensitive resin layer results in more air voids. This finding is important to the present invention.

In accordance with the present invention, a first embodiment is provided having the elements recited in claim 1, a second embodiment is provided having the elements recited in claim 19, a third embodiment is provided having the elements recited in claim 36, a fourth embodiment is provided having the elements recited in claim 38, a fifth embodiment is provided having the elements recited in claim 42, and a sixth embodiment is provided having the elements recited in claim 43. Each of these embodiments is directed to a photosensitive film wherein "the number of fish eyes having a diameter of at least 80 μm included in said protecting film" does not exceed "5 fish eyes/m^2 when measured under a microscope at a

multiplication of 100," and each of these embodiments require the photosensitive resin layer to have a "film thickness of 5 to 50 μm."

Various other embodiments are recited in the dependent claims. One important advantage of the photosensitive films, in accordance with the present invention, is the size and number of fish eyes in the fish eye population. The relatively small and few fish eyes in the protecting film of the photosensitive films of the present invention improve quality and yield of semiconductor elements when manufacturing semiconductor elements.

Applicants' Arguments

The Examiner's rejections are all predicated on the notion that the "protecting film (C) would have the same number of fish eyes at the given diameter no matter how it is evaluated" (Office Action, dated March 24, 2004, page 2, lines 11-16). From this factual predicate, the Examiner concludes that the limitation wherein "the number of fish eyes having a diameter of at least 80 μm included in said protecting film (C) does not exceed 5 fish eyes/m^2 when measured under a microscope at a multiplication of 100" does not further limit the claims. The Examiner's conclusion is unsupported for the following reasons.

First, a "fish eye" is a defect in the protecting film of a precursor to a fully manufactured semiconductor element (See instant specification, page 1, line 6 to page 3, lines 8-10). Fish eyes cause "air voids" to form in latter stages of semiconductor manufacturing (See instant specification, page 3, lines 17-21). Air voids are defects formed in an intermediate precursor to the fully manufactured semiconductor element, and air voids result in the formation of defective patterns and breakage when exposing, developing and etching to complete the manufacture of the semiconductor element (See instant specification, page 3,

lines 22-28). It is an object of the present invention to provide a protecting film with a reduced number of "fish eyes" (i.e., a *de minimis* "fish eye" population) so as to improve the yield of high quality semiconductor elements after the manufacturing process has been completed (See instant specification, page 4, lines 22, to page 5, line 19).

Second, while the absolute number and size of "fish eyes" in the "fish eye" population is independent from the method of evaluation applied, comparison of "fish eye" populations is not independent of the method of evaluation applied. In other words, the method of evaluation applied when evaluating a protecting film will affect the accuracy and precision of the characterization of the "fish eye" population within the material of the protecting film. By accurately and precisely characterizing the "fish eye" population in the protecting film of the present invention, the Applicants distinguish their superior photosensitive film from those of the prior art.

For example, a protecting film in accordance with the present invention is characterized in that "the number of fish eyes having a diameter of at least 80 μm does not exceed 5 fish eyes/m^2." The Examiner contends that it does not matter whether the number of fish eyes per square meter has been measured by the naked eye or with a microscope. The Examiner's contention assumes that the accuracy of measurement is the same for both the naked eye and with the aid of a microscope (Office Action, page 5, line 21, to page 6, line 4).

The Examiner's contention fails because visual resolution acuity with the naked human eye is limited to about 89 μm (See Appendix A). This means that a "fish eye" has to have a diameter of about 89 μm or larger for the naked eye of an average person to see it. Consequently, "fish eyes" that are less than 89 μm will be missed when measuring with the

average unaided human eye. In addition, the "fish eyes" must be separated from each other by at least 89 μm, otherwise, the naked human eye will perceive only a single large "fish eye."

Thus, measurement of "fish eyes" with the naked eye will result in a certain degree of error, which is greater than the measurement error obtained when using a microscope. "Fish eyes" having a diameter between 80-89 μm are likely to be missed by the naked eye. Adjacent "fish eyes" that are separated by less than 89 μm will be perceived by the naked eye as a single large "fish eye." To facilitate the Examiner's understanding of the measurement error issue, Applicant provides the following illustration below (Illustration 1).

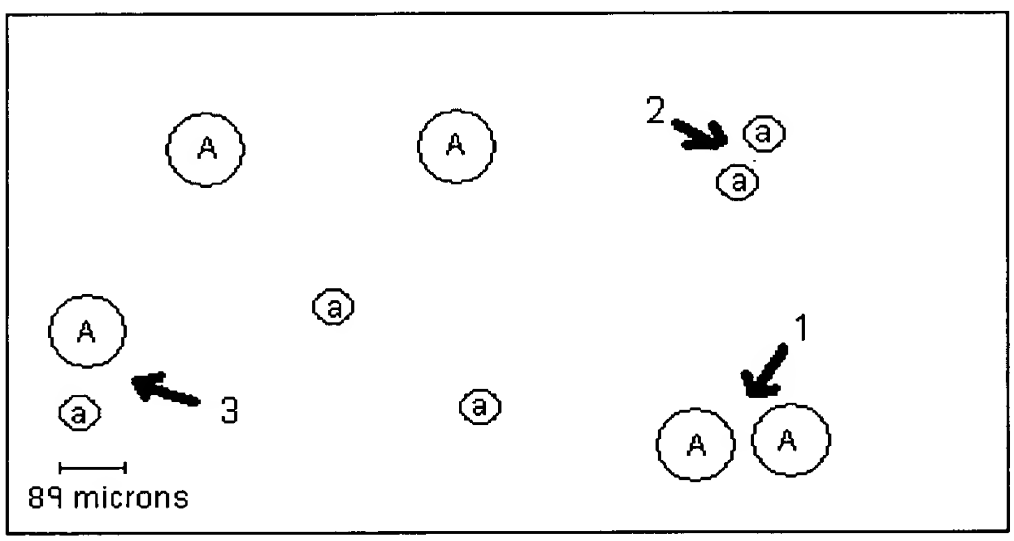

Illustration 1

Illustration 1 represents a plan view of a hypothetical protecting film having large fish eyes (A) and small fish eyes (a). The large fish eyes all have a diameter greater than 89 μm, and the small fish eyes all have a diameter less than 89 μm but greater than 80 μm. Three groups of fish eyes (1), (2) and (3) are shown, where each group contains two fish eyes that are separated by less than 89 μm. In the present illustration, an evaluator measuring the

number of "fish eyes" with his naked eyes would perceive only five fish eyes. This is because the three paired "fish eyes" in Groups (1), (2) and (3) would meld together and be perceived as only three fish eyes. This assumes that the two "fish eyes" in Group (2) would be perceived as one fish eye eventhough Group (2) consists of two small fish eyes. All of the remaining small fish eyes (a) are too small to be detected by the evaluator's naked human eye.

On the other hand, an evaluator using her microscope for magnifying the field by a factor of 100 would perceive all 10 "fish eyes." A person skilled in the art would realize that a measurement of "fish eyes" using a microscope would provide a more accurate and precise measurement of the number of "fish eyes" per square meter than measuring with the naked eye alone. As taught by Hans C. Ohanian (See Ohanian, H.C.: "Physics." W.W. Norton & Co., Inc., New York, 1985, pp. 847-850), a microscope is a magnifier that makes it possible to see fine detail with the human eye.

In the present example provided by Illustration 1, the evaluator using her naked eye would conclude that the protecting film shown in the illustration has five "fish eyes" having a diameter of at least 80 μm, whereas the evaluator using the microscope at a magnification of 100 would realize that the same film actually has ten "fish eyes." <u>The different values for the number of "fish eyes" measured per unit area is substantial and depends on the measurement technique applied</u>. Assuming that the measured area for Illustration 1 represented a square meter, the evaluator using her naked eye would erroneously conclude that the protecting film had a "fish eye" population that did not exceed five fish eyes per m^2, and that it fell within the scope of the present invention. On the other hand, the evaluator using the microscope would know that the protecting film actually had a "fish eye" population of ten fish eyes per m^2, and that the protecting film did not fall within the scope of the present claims.

In view of the above explanatory example, the Examiner should realize that the manner in which the "fish eyes" are evaluated is an important limitation of the present claims because it characterizes the "fish eye" population within the protecting film, which is a structural limitation of the claims.

The Prior Art Rejections

Anticipation under 35 U.S.C. § 102 requires showing the presence in a single prior art reference disclosure of each and every element of the claimed invention, arranged as in the claim. Lindemann Maschinenfabrik GMBH v. American Hoist & Derrick, 221 U.S.P.Q. 481, 485 (Fed. Cir. 1984).

On the other hand, a patentability analysis under 35 U.S.C. § 103 requires (a) determining the scope and content of the prior art, (b) ascertaining the differences between the prior art and the claimed subject matter, (c) resolving the level of ordinary skill in the pertinent art, and (d) considering secondary considerations that may serve as indicia of nonobviousness or obviousness. Graham v. John Deere Co. of Kansas City, 148 U.S.P.Q. 459, 467 (1966). Furthermore, a proper rejection under Section 103 further requires showing (1) that the prior art would have suggested to a person of ordinary skill in the art that they should make the claimed device or carry out the claimed process, (2) that the prior art would have revealed to a person of ordinary skill in the art that in so making or doing, there would have been a reasonable expectation of success, and (3) both the suggestion and the reasonable expectation of success must be found in the prior art and not in the applicants' disclosure. In re Vaeck, 20 U.S.P.Q.2d 1438, 1442 (Fed. Cir. 1991).

With these rules in mind, the Applicants address the Examiner's rejections of the present claims.

The Section 102 Rejection

The Examiner contends that U.S. Patent 4,360,582 to Taguchi (hereafter, the Taguchi Patent) teaches all of the subject matter of claims 1-10, 13-19, 21-25 and 28-37. Applicants strongly disagree.

The Taguchi Patent teaches a "photopolymerizable element" for producing photoresists used in manufacturing printed circuit boards that includes: (1) a layer of a photopolymerizable composition, (2) a film support laminated to the composition layer and optionally (3) a strippable protective film (see Abstract). The thickness of the composition layer is 0.1 to 1,000 μ (col. 9, lines 15-19) with the thickness of the film support being 5 to 100 μ (col. 9, lines 20-22) and the thickness of the protective film being 8 to 80 μ (col. 10, lines 22-23). Numerous materials are available for making the protective layer, but there is no mention of using low quality LDPE.

More specifically, the Taguchi Patent teaches that the protective film is provided on one surface of the photopolymerizable layer and the film support is laminated onto the other surface, wherein the protective layer is used for preventing blocking at the winding step and adhesion of dust during handling (col. 3, lines 62-68). The Taguchi Patent teaches that the film support is a transparent film capable of being dissolved or dispersed in a developer, and that the film support is selected from the group consisting of methyl methacrylate homopolymer and copolymers, vinyl chloride homopolymer and copolymers, polyvinyl alcohol, and mixtures thereof (col. 4, lines 51-62). The Taguchi Patent teaches the use of

trimethylolpropane trimethacrylate as a photopolymerizable monomer for making a photopolymerizable layer, but that other materials such as the methyl methacrylate homopolymer and copolymer and a list of other compounds would be used as an organic polymer binder (col. 5, line 27, to col. 6, line 23).

The Taguchi Patent teaches that the use of polyethylene terephthalate as the film support has certain disadvantages, such a tendancy for the photosensitive layer to be destroyed when stripping the film support when the thickness of the photosensitive layer is reduced (col. 2, line 38, to col. 3, line 8). The Taguchi Patent also teaches that the protective film could be selected from a polyethylene terephthalate film, a polypropylene film, a polyethylene film, a cellulose triacetate film, a cellulose diacetate film, a polyamide film, a polytetrafluoroethylene film, a paper, a polyethylene-laminated paper and a polypropylene-laminated paper (col. 10, lines 15-24).

It is important to note that Taguchi teaches that the protective film (10), such as shown in Figure 4, is an optional feature of the photopolymerizable element (col. 14, lines 57-60). Furthermore, it is important to note that while Taguchi provides certain examples of a photosensitive element utilizing the optional protective film, and these examples focus primarily on the use of a polyethylene film (col. 18, lines 9-52).

As admitted by the Examiner (Office Action, dated November 27, 2001, page 5, lines 7-8), the Taguchi reference does not teach "explicit details pertaining to the protective film" such as a protecting layer that has the number of fish eyes having **a diameter of at least 80 μm that does not exceed 5 fish eyes/m^2** when measured under a microscope at a multiplication of 100. The Examiner reiterates in the outstanding Office Action that "Taguchi is silent on fish eyes" (Office Action, dated March 24, 2004, page 4, line 1).

The Examiner now contends that while the Taguchi Patent is completely silent with respect to the claimed feature of "fish eyes" it would be an inherent feature of the strippable protective film taught by the reference (Office Action, dated March 24, 20044, page 4, lines 1-3). However, the Examiner's inherency argument is flawed for the following reason.

The Federal Circuit has ruled that inherency may not be established by probabilities or possibilities, and the mere fact that a certain thing may result from a given set of circumstances is not sufficient to establish inherency. Continental Can Co. USA Inc. v. Monsanto Co., 20 U.S.P.Q.2d 1746, 1749 (Fed. Cir. 1991). Instead, the teachings of the disclosure must be sufficient to show that the inherent feature would be the "natural result" flowing from what is taught. Id.

In the present case, the Taguchi Patent is not only silent with respect to "fish eyes," it is also completely silent with respect to "air voids" and any other defects related to imperfections in the protective layer. Instead, the authors of the Taguchi Patent focus on non-uniform adhesion between the photosensitive layer and a substrate, which results in damage to the photosensitive layer when the film support is stripped therefrom (col. 2, lines 48-55). In other words, the disclosure of the Taguchi Patent is not sufficient to establish that the protective films it discloses would naturally have "fish eyes having a diameter of at least 80 μm included in the protecting film" in numbers that "does not exceed 5 fish eyes/m^2 when measured under a microscope at a multiplication of 100" as required by independent claims 1, 19, 36, 38, 42 and 43.

The present specification, on page 14, lines 12-16, teaches that "protecting films" made in accordance with the present invention have the recited "fish eye" population because they are produced using specifically modified methods of film production, such as methods

that filter the raw material resin after thermal melting. The present specification then goes on to list multiple commercially available polypropylene films that meet the "fish eye" population requirement (See present specification, page 14, lines 17-22).

In addition, Applicants present the following excerpt from "Plastic Films – Processing and Application (2nd Ed.)" edited by Toshiaki Okiyama, pp. 88-91 and 242-243. This textbook teaches there are multiple film forming methods as compiled in Table 2.12 on p. 89, reproduced in English below for the Examiner's convenience.

<u>Table 2.12 Film-forming methods of polypropylene film</u>

1) Inflation method
2) T-die method (or cast film)
3) Stretching method
   - Biaxial stretching
     - Equal stretching (balance type)
     - Biased stretching (unbalance type)...sligh
   - Monoaxial stretching (stretched tape)

The "Plastic Films" textbook also teaches that different film properties result depending upon the film-forming method used. In Table 4.40 of the "Plastic Films" textbook the properties of polypropylene films are compared between films produced by casting and those produced by biaxial stretching. Table 4.40 of page 243 of the "Plastic Films" textbook is reproduced below, in English, for the Examiner's convenience.

Table 4.40 Properties of Polypropylene Films

Film-forming method	Casting	Biaxial stretching
Specific gravity	0.885 – 0.895	0.902 – 0.907
Tensile strength (kg/mm^2)	3.2 – 7.0	8.4 –23.2
Breaking extension (%)	500 - 1000	20 - 200
Tear propagation strength (g/25 μ)	Longitudinal 600 Traverse 25	7 - 20
Impact strength (kg cm (25 μ)	1 - 3	12 - 20

In view of the multiple film-forming methods available and the heterogeneous properties that result depending upon which film-forming method is used, it would be clear to a person skilled in the art that a film characteristic, such as the formation of "fish eyes," would be dependent upon the film-forming method used. The application of polypropylene to Example 1 provided in the Taguchi Patent includes no description as to the manufacturer, production conditions, and other variables, which would effect the formation of the "fish eye" population of the film. Therefore, even for a person skilled in the art, it is impossible to determine what kind of polypropylene, with what properties, was used in the Taguchi Patent.

There is absolutely no teaching in the Taguchi Patent sufficient to establish that the protective films described in col. 10, lines 15-23, of the reference have been in any way specially modified to ensure "fish eyes having a diameter of at least 80 μm included in the protecting film" in numbers that "does not exceed 5 fish eyes/m^2 when measured under a microscope at a multiplication of 100" as recited in the present claims. There is no clear and reasonable basis, provided by the Taguchi Patent, to support the Examiner's conclusion that the polypropylene protective film taught by Taguchi inherently would have the claimed population of "fish eyes."

For this reason, the Examiner's inherency argument is untenable and must be withdrawn.

As admitted by the Examiner (Office Action, dated March 24, 2004, page 4, line 15-17, and on page 5, lines 8-10), the Taguchi Patent does not teach, or even suggest, the subject matter of claims 11, 12, 26 and 27.

The Taguchi Patent teaches the disadvantages of polyethylene terephthalate support films (col. 2, line 38, to col. 3, line 8), and instead teaches using methyl methacrylate homopolymer and copolymers and various other materials (col. 4, lines 50-60). The Taguchi Patent actually teaches away from the use of polyethylene terephthalate support films; therefore, the Taguchi Patent cannot anticipate the subject matter of new independent claim 38.

In addition, the Taguchi Patent does not teach, or even suggest, that "the protecting film (C) is made of resin filtered after thermal melting" as recited in new dependent claims 39 to 41.

The Section 103 Rejections

The rejections posited under 35 U.S.C. § 103 are untenable for the following reasons.

The Taguchi Patent

The Taguchi Patent has been adequately characterized above. As admitted by the Examiner, it does not teach or even suggest that "the monomer (b) is bisphenol A polyoxyalkylene diacrylate, or contains bisphenol A polyoxyalkylene dimethacrylate as a component" as recited in claims 11 and 26, and that "the photopolymerization initiator (c) contains 2,4,5-triarylimidazole dimer" as recited in claims 12 and 27.

The Hatanaka Patent

U.S. Patent 6,133,343 to Hatanaka (hereafter, the Hatanaka Patent) teaches a "resinous composition for dental use," which has absolutely nothing to do with photosensitive films. More specifically, the Hatanaka Patent teaches a resinous composition for dental use that neither stains nor discolors while in use in a mouth for long periods of time, wherein the composition includes an impact-resistant resinous complex composed of (meth)acrylic polymer and core-shell structured polymer particles having at least one hard polymer, at least one soft polymer layer, and an outermost hard polymer layer (See Abstract).

The Hatanaka Patent teaches that the monomers constituting the hard polymer layer and the soft polymer layer may include poly-functional (meth)acrylates, such as bisphenol A dimethacrylate, trimethylolpropanetri(meth)acrylate, and 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane (col. 3, lines 61, to col. 4, line 17, and col. 5, line 58, to col. 6, line 28). The Hatanaka Patent teaches that these poly-functional (meth)acrylates are suitable for

making impact-resistant resinous complexes. The Hatanaka Patent does not teach that these polyfunctional (meth)acrylates are suitable for use as polymer, having the required sensitivity, resolution, adhesiveness and mechanical properties needed for practicing a photosensitive film in accordance with the present invention (See instant specification, page 8, lines 11, to page 9, line 25).

The Hoffman Patent

United States Patent 4,710,446 to Hoffman et al. (hereafter, the Hoffman Patent) teaches "photosensitive recording materials" for the production of lithographic printing plates or resist images that include a photosensitive, photopolymerizable recording layer, wherein the recording layer contains a polymeric binder provided by a copolymer soluble or dispersible in aqueous medium and a comonomer (See Abstract). The comonomer is an anhydride of a polymerizable, ethylenically unsaturated monocarboxylic acid (See Abstract). The Hoffman Patent teaches that 2,4,5-triarylimidazole dimers are suitable photoinitiators for the photosensitive, photopolymerizable layers (col. 6, lines 9-37).

The Examiner's rejection of claims 11 and 26, under 35 U.S.C. § 103, in view of Taguchi in view of Hatanaka is untenable for the following reason. The Examiner's rejection depends upon the first premise that the Taguchi Patent teaches the use of trimethylolpropane trimethacrylate as a photopolymerizable monomer for making a photopolymerizable layer. The second premise asserted by the Examiner is that the Hoffman Patent teaches the equivalence of trimehylolpropane trimethacrylate and 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane for making photopoymerizable layers (Office Action, March 24, 2004, page 4, lines 21-25). The second premise is flawed because the Hatanaka Patent teaches the

equivalence of trimehylolpropane trimethacrylate and 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane for making impact-resistant resinous complexes.

Because the Examiner's second premise is flawed, the Examiner's subsequent conclusion drawn therefrom is clearly erroneous. The Examiner's third premise asserted is that 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane is a type of bisphenol A polyoxyalkylene dimethacrylate (Office Action, dated March 24, 2004, page 4, lines 21-23). The Examiner's line of reasoning fails to teach bisphenol A polyoxyalkylene dimethacrylate as a monomer for making photopolymerizable layers because the Hatanaka Patent teaches the equivalence of trimehylolpropane trimethacrylate and 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane for making impact-resistant resinous complexes used in dental work, and not equivalence in making photosensitive films for semiconductor manufactures. Consequently, there is no teaching grounded in the prior art, and not solely the Applicants' disclosure, teaching the use of bisphenol A polyoxyalkylene dimethacrylate as a monomer in the manufacture of a photosensitive film, in accordance with the invention recited in claims 11 and 26. The Hoffman Patent, being directed to the use of certain photoinitiators, does not make up this deficiency in the teachings of the Taguchi Patent and the Hatanaka Patent.

The Examiner's rejection of claims 12 and 27, under 35 U.S.C. § 103, in view of Taguchi in view of Hoffman is untenable for the following reason. The Taguchi Patent relates to a photopolymerizable element. The Hoffman Patent relates to photosensitive recording materials, and has nothing to do with photopolymerizable elements. There is simply nothing about the Hoffman Patent that pertains to the prevention of air voids and fish eyes. Therefore, there would be no reasonable motivation to combine the teachings of the Hoffman Patent with the teachings of the Taguchi Patent.

Conclusion

The Examiner's rejection under 35 U.S.C. § 102 is untenable and should be withdrawn because the Taguchi Patent does not teach, or even suggest, a "protecting film" having a "fish eye" population with ""the number of fish eyes having a diameter of at least 80 μm included in said protecting film does not exceed 5 fish eyes/m^2 when measured under a microscope at a multiplication of 100" as recited in independent claims 1, 19, 36, 38, 42 and 43. Furthermore, the Taguchi Patent does not teach, or even suggest, that "the protecting film (C) is made of resin filtered after thermal melting" as recited in dependant claims 39, 40 and 41.

The Examiner's rejection of claims 11 and 26 (now new claims 42 and 43) under 35 U.S.C. § 103 is untenable and should be withdrawn because the Hatanaka Patent does not teach equivalence of trimehylolpropane trimethacrylate and 2,2'-di(4-methacryloxypoly ethoxyphenyl)propane for making photosensitive films for semiconductor manufactures; instead, the reference reasonably teaches the equivalence of these compounds in making impact-resistant resinous complexes used in dental work. As a result, the inferences made by the Examiner in order to justify combining the teachings of the Hatanaka Patent with the teachings of the Taguchi Patent are flawed. A proper motivation to combine references cannot be justified on the basis of erroneous assumptions.

For all of the above reasons, claims 1-10, 12-19, 21-25 and 27-43 are in condition for allowance, and a prompt notice of allowance is respectfully requested.

Questions are welcomed by the below-signed attorney for applicants.

Respectfully submitted,

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APPENDIX

Human visual resolution acuity is limited to about 89 μm as evident from the following information and related calculation. The NDT Resource Center webpage (www.ndt-ed.org/Education Resources/CommunityCollege/PenetrantTest/ Introduction/visualacuity.htm) teaches that the limits of normal human visual acuity is resolution to about 0.00349 inches. On this basis, the following calculation was performed:

$$(0.00349\ \text{in})(2.54\ \text{cm/in})(10\ \text{mm/cm})(1000\ \mu\text{m/mm}) = 88.6\ \mu\text{m}$$

Therefore, the limits of human visual resolution acuity is about 89 μm.